



Rapid, Comprehensive, Mission Architecting at the Jet Propulsion Laboratory

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Lead Engineer, Team-X

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Space Applications Conference

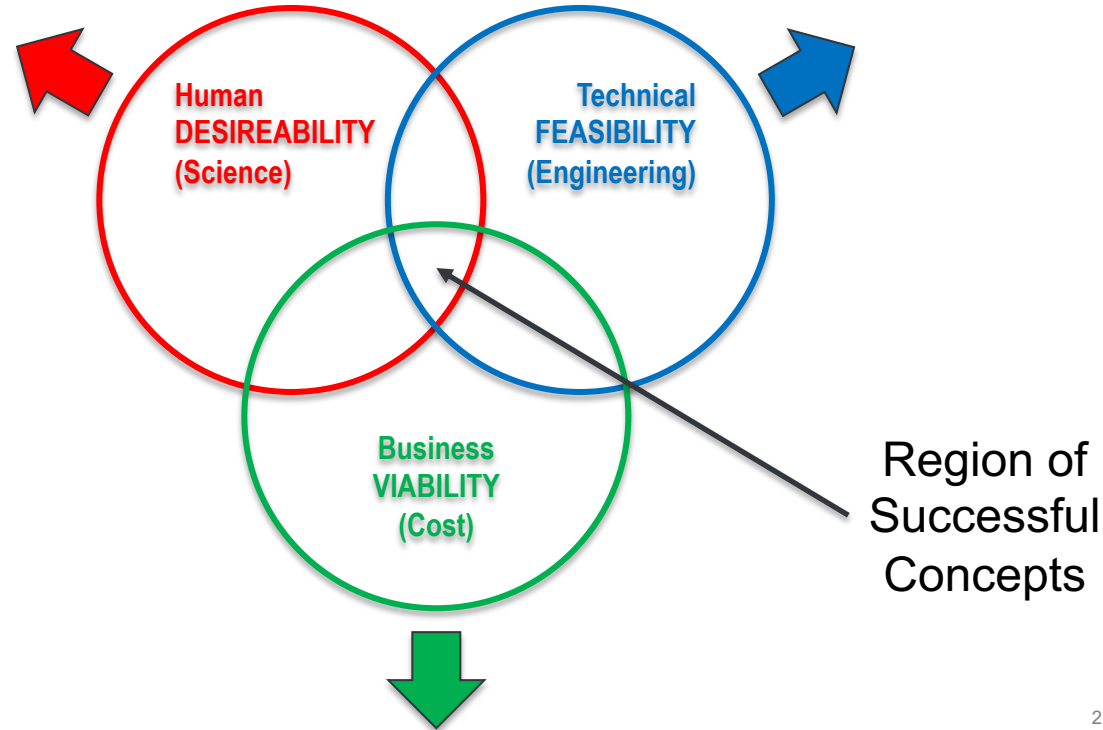
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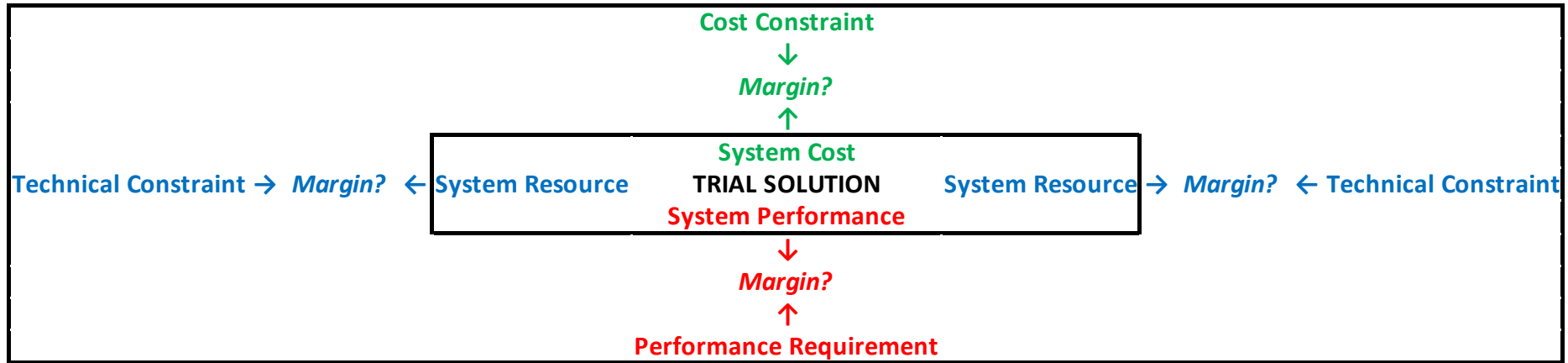
The Challenge of Pre-Phase A

Answering the question, “*Why can’t I have what I want?*”
so that all stakeholder groups believe the answer, simultaneously.



Solution: Concurrent Constraint & Requirement Margins Visualization

Does the trial solution fit in the box in all dimensions?



Applied to Segment Level Architecture

The “S-Chart”

Mission Cap		\$\$\$\$					
Segment Allocation		\$\$		\$\$			\$\$
Element Allocation				\$		\$	
		Margin?		Margin?		Margin?	Margin?
Segment/Element Estimate		\$\$		\$		\$	\$\$
Segment/Element Description							
				P/L Element		S/C Element	
SWaP(D)		Launch Segment		Flight Segment			Ground Segment
> Technical Resources <	Size (Volume)	Capability					
		MEV	Margin?		Margin?		
	Weight (Mass)	Capability					
		MEV	Margin?		Margin?		
	Power (Orbit Avg.)	Capability					
		MEV			Margin?		
	(Daily Avg.) Data Rates	Capability					
		MEV			Margin?	Margin?	
	Segment/Element Description		Orbit: Altitude, Inclination,				# Passes, Duration, Band
	Segment/Element Estimate		Spatial and Temporal Coverage, Sampling Frequency,...	Resolutions: Radiometric, Spatial Spectral Temporal	Pointing: Knowledge, Control, Stability, Slew		Data Volume
		Margin?		Margin?		Margin?	Margin?
System Requirement		Spatial and Temporal Coverage, Sampling Frequency,...		Resolutions: Radiometric, Spatial Spectral Temporal	Pointing: Knowledge, Control, Stability, Slew		Data Volume

^ Science Performance ^

Applied to Segment Level Architecture

Concurrent

Mission Cap		Mission Cap					
Segment Allocation		\$\$		\$	\$\$	\$	\$\$
Element Allocation							
Segment/Element Estimate		Margin?		Margin?		Margin?	Margin?
Segment/Element Description							
SWaP(D)		Launch Segment		P/L Element		S/C Element	
> Technical Resources <	Size (Volume)	Capability					
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	Weight (Mass)	Capability					
		MEV	Margin?		Margin?		
	Power (Orbit Avg.)	Capability					
		MEV			Margin?		
	(Daily Avg.) Data Rates	Capability					
		MEV			Margin?	Margin?	
	Orbit: Altitude, Inclination,						# Passes, Duration, Band
	Segment/Element Description						
		Spatial and Temporal Coverage, Sampling Frequency,...		Resolutions: Radiometric, Spatial Spectral Temporal		Pointing: Knowledge, Control, Stability, Slew	Data Volume
Segment/Element Estimate		Margin?		Margin?		Margin?	Margin?
		Spatial and Temporal Coverage, Sampling Frequency,...		Resolutions: Radiometric, Spatial Spectral Temporal		Pointing: Knowledge, Control, Stability, Slew	Data Volume
System Requirement							

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Applied to Segment Level Architecture

Collaborative

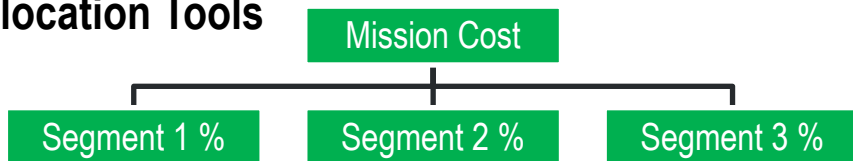
Mission Cap		\$\$\$\$					
Segment Allocation		\$\$		\$\$			\$\$
Element Allocation				\$		\$	
Segment/Element Estimate		Margin?		Margin?		Margin?	Margin?
Segment/Element Description							
				P/L Element		S/C Element	
SWaP(D)		Launch Segment		Flight Segment			Ground Segment
> Technical Resources <	Size (Volume)	Capability		Margin?		Margin?	
		MEV					
	Weight (Mass)	Capability		Margin?		Margin?	
		MEV					
	Power (Orbit Avg.)	Capability				Margin?	
		MEV					
	(Daily Avg.) Data Rates	Capability				Margin?	Margin?
		MEV					
	Segment/Element Description		Orbit: Altitude, Inclination,				# Passes, Duration, Band
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			Margin?	Margin?		Margin?	Margin?
System Requirement			Spatial and Temporal Coverage, Sampling Frequency,...	Resolutions: Radiometric, Spatial Spectral Temporal		Pointing: Knowledge, Control, Stability, Slew	Data Volume

^ Science Performance ^

Required Infrastructure

- **Personnel**
 - Facilitator, Segment Subject Matter Experts (Launch Segment, Instruments, Spacecraft, Ground Systems)

- **Cost Allocation Tools**

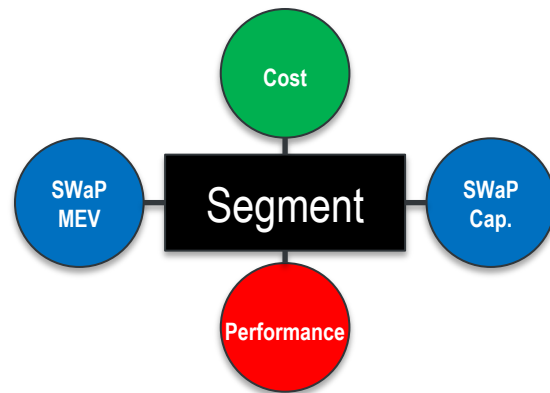


- **Segment Level Analogy Database with Attributes**

- **Parametric Attribute Relationships**

$$\frac{\partial Attribute_i}{\partial Attribute_j} \text{ for all } i,j$$

- **Projection Facility**



Benefits

- Factor of 2 in Session Duration
 - Sometimes multiple architectures in 3 hours, compared to 6 hour typical Team-X study.
- Stakeholder Buy-In
 - Inconsistencies immediately apparent
 - Problems don't disappear into another dimension, they get backed up against a wall.
 - Multiple trial solutions can be examined.



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